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ORIGINAL RESEARCH

A tablet-based program to enable people with intellectual and other disabilities to access leisure activities and video calls

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ABSTRACT

Purpose: This study evaluated a tablet-based program to help eight participants with moderate intellectual disability, sensory and/or motor impairments, and lack of expressive or expressive and receptive verbal skills to select and access leisure activities and video calls independently.

Methods: The program relied on the use of a tablet (i.e., Samsung Galaxy Tab S2 LTE) with 8-inch screen, Android 6.0 Operating System, front camera, proximity sensor and multimedia player. The tablet was fitted with a SIM card and two specific applications, that is, WhatsApp Messenger for making video calls and MacroDroid for automating the tablet's functioning in accordance with the program conditions. The tablet presented pictures concerning leisure activities and preferred partners for video calls. The participant could select any activity or partner by touching (or nearing his or her hand to) the tablet's proximity sensor.

Results: During the baseline (i.e., without the program), the participants failed to access leisure activities or video calls. During the post-intervention phase (i.e., with the program), they selected and accessed those activities and calls independently and spent between about 75% and 90% of the session time engaging with them.

Conclusion: The tablet-based program can be highly beneficial for people like the participants of this study.

➤ IMPLICATIONS FOR REHABILITATION

- A technology-aided program may enable persons with intellectual and other disabilities to independently access leisure activities and communication with distant partners.
- The program may involve the use of video calls to allow communication to participants with limited or no verbal skills.
- The program may be realized using a tablet (a) including Android 6.0 Operating System, proximity sensor, and multimedia player, and (b) fitted with a SIM card and applications such as WhatsApp Messenger and MacroDroid.
- The program may be easily adapted to the participants' characteristics in terms of activities available and partners to reach.

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Leisure; communication; tablet; intellectual disability; video calls

Introduction

People with moderate-to-severe intellectual or multiple disabilities can encounter serious obstacles in managing functional daily activities, leisure activities, and basic communication with partners not present in their immediate environment [1–5]. Their problems with functional daily activities may be largely due to their inability to determine the time of the day when the activities are to occur and to remember the material and the steps comprised in those activities [6–8]. Their failures to independently engage in leisure activities may be related to their inability to appropriately use conventional devices available for selecting and accessing those activities (e.g., music devices, computers and tablets) [9–11]. Similarly, their failures to get in contact with distant partners may be due to their inability to use telephone devices or functionally equivalent computer-aided systems independent of staff or family assistance [12–14].

Given the relevance of enabling these people to gain independence in each of the aforementioned areas and the unlikelihood of achieving such an objective without the support of relevant assistive technology, several intervention programs have been developed, which rely on specially arranged technology solutions [11,14–19]. Those programs were generally focused on one specific area (e.g., communication or leisure) [9,15,20–23]. However, it could be argued that offering people with intellectual and other disabilities the opportunity to be independently and freely engaged in different areas (i.e., in different types of activities) would be beneficial for them. It would allow them to shift from one area to the other (i.e., to vary their engagement), with a

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likely improvement in the quality of their performance and in personal satisfaction [24–26].

In line with this view, three technology-based intervention programs have been recently developed for helping people select and access leisure and communication activities independently. In one of those programs [2], eight participants with intellectual disability and sensory or sensory-motor impairments were provided with a computer-aided system that allowed them to select and access various leisure activities (e.g., listening to music and watching videos) and to select and reach via telephone calls or text messages distant communication partners. Initially, the participants were presented with the leisure and communication options and could select one or the other via a microswitch (e.g., an easy-to-use pressure or optic sensor). Selection of leisure or communication led the computer to provide a list of leisure activities or communication partners. Selection of one of the leisure activities allowed the participant to access that activity. Selection of one of the partners allowed the participant to start a telephone call or send a message to that partner.

Lancioni et al. [11] assessed the possibility of replacing the aforementioned computer-aided program with a simpler, smartphone-based program for five participants with intellectual disability and visual impairment or blindness. The smartphone was supplied with multiple leisure activity files as well as the names and telephone numbers of a group of relevant communication partners. The participants, who possessed clear speech, operated the smartphone via specific verbal utterances, which were discriminated by the smartphone's S-voice. In practice, those utterances served to (a) open the intended leisure activity files and thus access the corresponding leisure activities or (b) start telephone calls to the communication partners selected.

Lancioni et al. [24] assessed a modified version of the aforementioned smartphone-based program with five participants who presented with intellectual disability, visual impairments and poor speech (i.e., insufficient to activate the smartphone's S-voice). To bypass the speech problem, the modified program (a) allowed the participants to use mini objects or pictures to select/access the activities and (b) involved the utilization of two smartphones. The objects or pictures were fitted with frequency code labels that made them identifiable. In fact, placing a mini object or picture in contact with one smartphone led this to recognize the code label and verbalize the related (selected) leisure or communication activity. Such verbalization activated the S-voice of the second smartphone, which then presented the corresponding leisure activity or connected the participant with the selected communication partner.

The positive results of the aforementioned programs may be viewed as encouraging for participants who can manage some level of verbal communication (i.e., to interact with the partners) in addition to enjoying leisure activities. The same programs, however, may be less than satisfactory (or inadequate) for people who (a) do not possess expressive verbal skills or (b) lack both receptive and expressive verbal skills (e.g., due to hearing loss). To offer these people a more satisfactory or viable level of communication/contact with preferred distant partners, one may need to resort to video calls. Video calls would grant those people (a) direct visual and emotional contact with the partners, (b) exposure to the partners' words, gestures and other recognizable (e.g., love) expressions and (c) opportunities to respond to the partners by means of simple gestures or other movements/expressions.

Video calls have been pointed out as (a) a promising tool to promote communication between persons using sign language [27–29] and (b) a possible way to allow communication between people with extensive motor impairment using technology-aided writing and partners using typical speech utterances [30]. The present study aimed to extend the assessment of video calls with participants with intellectual disabilities, sensory and/or motor impairments, and lack of expressive or expressive and receptive verbal skills. In practice, these participants were allowed to access video calls as well as leisure activities [31,32]. The video calls replaced the regular (voice) telephone calls used in the studies reviewed above. To pursue this objective, the study relied on a tablet-based program, which was implemented with eight participants.

Methods

Participants

Table 1 lists the participants by their pseudonyms and reports their chronological ages, sensory and/or motor impairments, and Vineland age equivalents for daily living skills (personal subdomain) [33,34]. The participants, whose chronological ages ranged between 25 and 66 years, attended rehabilitation and care centres and represented a convenience sample [35]. Psychological records indicated that their intellectual disability was estimated to be in the moderate range, but no IQ scores were available. Vineland age equivalents for personal daily living skills were above 4 years for four participants and below 3 years for the other four participants (i.e., Brian, John, Martin and Betty) who were affected by serious motor impairments.

Brian, John, Susan and Martin had functional hearing and were known to understand simple sentences dealing with routines and relevant people (e.g., sentences concerning daily activities and family members). They were unable to produce elaborate/clear verbal expressions, but used vocalizations to indicate, among others, happiness, agreement and disagreement. Betty was affected by moderate hearing loss, partly compensated by hearing aids. She was known to understand a few words and discriminate gestures used in her daily context to express events/activities, as well as emotions and greetings. She could also use "yes" and "no"

Table 1. Participants' pseudonyms, chronological age, sensory and/or motor impairments, and Vineland age equivalents for personal daily living skills.

Participants (Pseudonyms)	Chronological Age (years)	Sensory and/or motor Impairments	Vineland age equivalents[a,b]
Tim	26	Severe hearing loss	4;5
Lindsey	66	Severe hearing loss	4;6
Brian	62	Spasticity with lack of ambulation	<1;0
Kathy	33	Severe hearing loss	4;3
John	32	Mild/moderate visual impairment and spasticity with need of support for ambulation	2;2
Susan	54	Moderate leg diplegia	4;2
Martin	51	Mild/moderate visual impairment and spasticity with reduced ambulation	2;9
Betty	25	Moderate hearing loss and spasticity with lack of ambulation	<1;0

[a]The age equivalents are based on the Italian standardization of the Vineland scales [33].
[b]The Vineland age equivalents are reported in years (number before the semicolon) and months (number after the semicolon).

head movements. Tim, Lindsey and Kathy had severe hearing loss precluding any verbal communication. They were known to understand gestures dealing with daily events/activities as well as emotions and greetings. They could also make a few of those gestures that could be decoded by staff and family members.

The participants were included in the study based on a number of conditions identified via staff interviews and direct observations. First, all participants had interest for a variety of leisure activities, such as watching videos with songs, comedy sketches, sport, advertisements and family events. Second, the participants with functional hearing seemed to prefer video calls to audio calls (i.e., they chose the former calls and also showed more attention and smiles, during such calls). Third, the four participants with hearing loss showed clear signs of communication/contact (e.g., smiles, "yes" and "no" movements, or gestures) during video calls. Conversely, they could not (or only partially) use audio calls due to their hearing loss. Fourth, staff had expressed interest in using a technology-aided program to support the participants' independent access to leisure activities and communication (contact) with distant partners. Given the participants' inability to read and sign a consent form for the study, their legal representatives had done so for them. The study complied with the 1964 Helsinki Declaration and its later amendments and was approved by a relevant Ethics Committee.

Setting, sessions and data recording

Familiar areas of the centres that the participants attended served as the setting for the study. Sessions were conducted on an individual basis, one to four times a day (depending on participant's availability), with the participant sitting at a desk and having a tablet in front of him or her. The sessions lasted 10 min or until any leisure or communication activity started before the 10-min limit had ended. Data recording was carried out by research assistants and concerned: (a) the leisure and communication activities that the participant selected/accessed independently within the sessions and (b) the engagement time for each of those activities (i.e., the time period spanning from the selection to the end of the activity). Inter-rater agreement was assessed in $>$20% of the participants' sessions. During those sessions, a research assistant and a reliability observer took part in data recording. Agreement required that the research assistant and reliability observer recorded the same activities and similar engagement times (i.e., differences smaller than 30 s). Agreement occurred in more than 90% of the sessions.

Technology

The technology consisted of a tablet (i.e., Samsung Galaxy Tab S2 LTE) with 8-inch screen, Android 6.0 Operating System, front camera, proximity sensor, and multimedia player. The tablet was fitted with a SIM card and two specific applications, that is, WhatsApp Messenger for making video calls and MacroDroid for automating/regulating the tablet's functioning in accordance with the program conditions (i.e., the conditions applying during the intervention and post-intervention phases; see below). The tablet was also supplied with a variety of (a) audiovisual files concerning leisure activities considered preferred for the participants (e.g., comic sketches, stories, songs, family pictures/videos and advertisements; see *Participants*) and (b) telephone contacts (numbers) for preferred communication partners such as family and staff members.

Experimental conditions and data analysis

The study was carried out according to a non-concurrent multiple baseline design across participants [36]. The participants' baseline phase, which varied in the number of sessions included, was followed by the intervention and post-intervention phases. The research assistants who conducted data recording (see above) were also responsible for setting up baseline, intervention and post-intervention sessions. They were experienced in the application of technology-aided programs with persons with disabilities and had regular contacts (i.e., exchanges of information) with one another to ensure procedural consistency. The participants' baseline and post-intervention data (i.e., session times they spent with the leisure and communication activities that they had selected and accessed independently) were graphed as means per session over blocks of sessions. A nonparametric statistical test (i.e., Kolmogorov–Smirnov) would be used to assess the differences between phases if overlaps between the data points of those phases existed [37,38].

Baseline. The baseline included four to eight sessions. The participant was provided with the tablet whose functioning had not yet been automated via MacroDroid to fit the program conditions (see intervention and post-intervention phases). At every session, the tablet was positioned horizontally in front of the participant. It showed three folders concerning leisure activities alternated with three communication options, which were arranged in two rows. The leisure folders appeared on backgrounds of different colour and were identified by written labels (e.g., comic sketches). The communication options consisted of the pictures/photographs of three preferred partners.

If the participant wanted to select a leisure activity (e.g., comic sketches), he or she was to touch the matching folder. In that case, the tablet presented pictures of four different alternatives (audiovisual files) available for that activity (e.g., Charlot and Mr. Bean). The participant was to touch one picture to access the related alternative. If the participant wanted to select a partner for a video call, he or she was to touch the picture of that partner. In that case, the tablet opened the WhatsApp chat specific for that partner. The participant was then to touch the tablet's video call icon to start a video call with that partner. If the participant did not succeed in using the tablet for about 5 min (given the difficult steps required by a standard, not automated tablet), the research assistant activated a song, comic sketch, or video call for him or her to limit frustration.

Intervention. The intervention phase included 10–14 sessions during which the participants used the tablet automated via MacroDroid to fit the program conditions. Every session started with the tablet presenting three pictures concerning leisure activities alternated with three pictures/photographs concerning preferred partners. The pictures were arranged in two rows and scanned (illuminated) individually for about 5 s. The participant could select a specific activity or partner by touching (or nearing his or her hand to) the tablet's proximity sensor when that activity or partner was scanned/illuminated. The proximity sensor was emphasized through coloured lines glued around it. Failure to select any of the pictures led the tablet to present six additional pictures (i.e., concerning three different leisure activities and three different partners).

Selection of a leisure activity picture led the tablet to present one of the four or five alternatives available for that activity (e.g., one of the four or five possible comic sketches). Selection of a partner led the tablet to start a video call with that partner through the WhatsApp Messenger. The activities were set to last about 1.5 min (i.e., a time deemed suitable for the participants).

No time limits were set for the video calls. At the end of an activity or video call, a new choice opportunity was available to the participant (i.e., through the process described above) provided that the 10-min period allowed for the session had not elapsed. If that period had elapsed, the session ended.

During the initial intervention sessions, the research assistant provided verbal and physical guidance to help the participant practice selection of (and access to) leisure and communication activities. During the following sessions, the research assistant's guidance was gradually eliminated to ensure that the participant was able to select and access both types of activities independently.

Post-intervention. During the 73–132 post-intervention sessions, conditions were identical to those in use at the end of the intervention phase. Research assistant's guidance was not available during the sessions.

Results

Figure 1 provides a summary of the baseline and post-intervention data for the eight participants. The figure does not report the participants' data during the 10–14 intervention sessions, which were aimed at enabling the participants to use the technology for selecting and accessing leisure and communication activities independently. The black squares and circles represent the mean percentages of session time the participants spent with leisure and communication activities selected and accessed independently over blocks of sessions, respectively.

During the baseline phase, the participants did not manage to select and access any of the activities independently; thus, they had a zero score for each measure. During the post-intervention phase, all participants managed to select and access leisure and communication activities independently. Their mean percentages of session time spent with leisure activities independently selected/accessed ranged between close to 30 and 55 (Betty and Susan, respectively). Their mean percentages of session time spent with communication activities independently selected/accessed ranged between over 25 and 50 (Tim and Betty, respectively). Their mean (cumulative) percentages of session time spent with the two types of activities ranged between about 75 and 90 (Brian and Susan, respectively). All participants except Betty had higher percentages of session time spent with leisure activities. Yet, the differences between the two percentages virtually disappeared for John and Susan during the last third of the post-intervention phase. Betty had higher percentages of session time spent with communication activities throughout the phase. Given the zero baseline scores and the high post-intervention percentages on the two types of activities combined (i.e., given the lack of overlap between the baseline and post-intervention combined data), no statistical test was deemed necessary to confirm that there was a significant performance difference between the two phases.

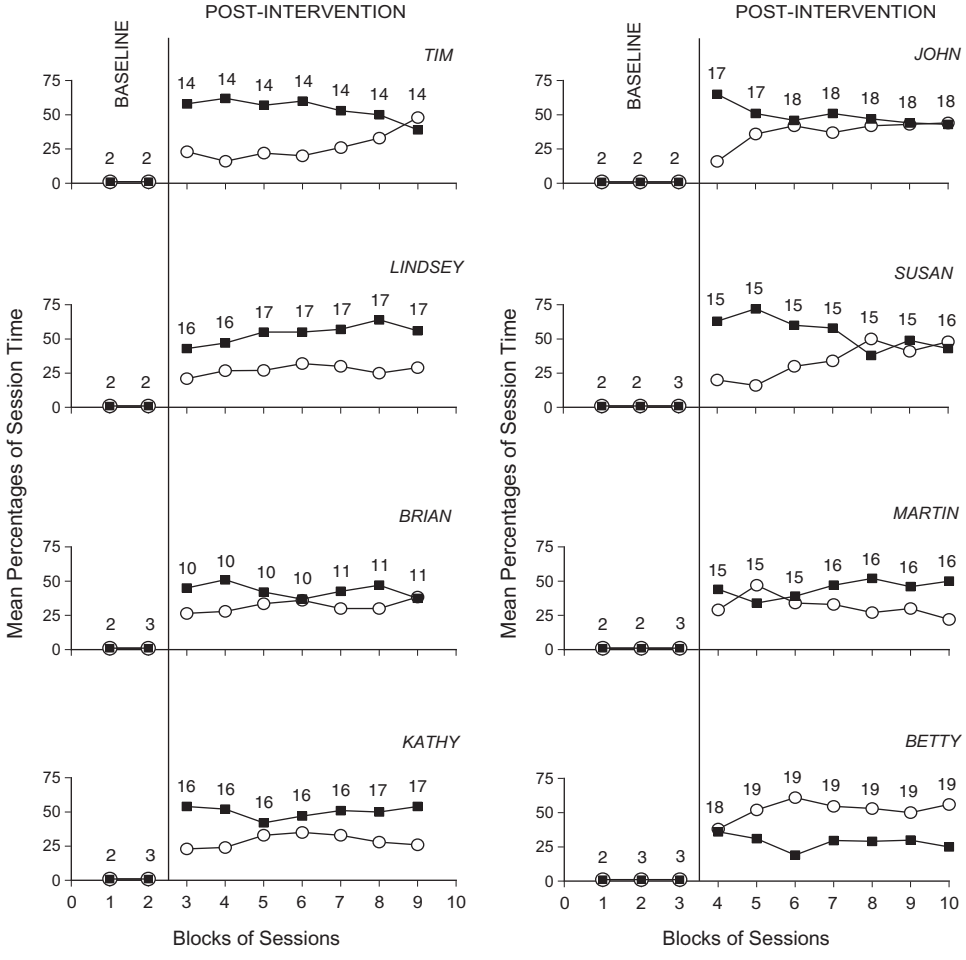

Figure 1. The eight panels summarize the data for the eight participants during the baseline and the post-intervention phases. The black squares and circles represent the mean percentages of session time the participants spent with leisure and communication activities, respectively. The number of sessions included in each block (square–circle combination) is indicated by the numeral above it.

Discussion

The results indicate that the tablet-based program was effective in supporting independent selection of and access to leisure and communication activities for participants with intellectual disabilities, sensory and/or motor impairments, and lack of expressive or both expressive and receptive verbal skills. These results (a) strengthen previous evidence on the overall appropriateness of technology-aided programs to help participants with disabilities engage in leisure and communication and (b) extend previous evidence in that the new program ensured access to video calls to participants who would have partial or no benefits from audio calls [11,24,31,39]. In view of the results, a few considerations may be put forward.

First, the participants engaged in the activities available for most of the session time throughout the post-intervention phase. The amount of time spent with the communication activities tended to be higher than or as high as that recorded in previous studies in the area (i.e., with participants who used audio calls) [11,24]. These two points may be taken to indicate that the program was suitable for the participants and the video calls were definitely interesting for them (i.e., capable of competing with their preferred leisure activities) [40]. In practice, these points may represent positive answers to general questions concerning (a) the viability, practicality and effectiveness of a technology-aided program combining leisure activities and video calls and (b) the overall relevance (i.e., attractiveness) of those calls for participants who may have reduced or no benefits from the use of audio calls due to their disabilities [41,42].

Second, the technology adopted for setting up the program is fairly affordable and easily available. In fact, the program relied on a specific tablet that could be (a) purchased for about US$500 and (b) fitted with (i.e., configured through) free or inexpensive applications to support the participants for both types of activities. The work necessary to arrange the tablet for the program (i.e., intervention and post-intervention sessions) can be considered fairly straightforward even though it requires a number of important steps. Indeed, one has to equip the tablet with (a) a multitude of activity files and related pictorial images that should be available to the participant during the sessions as well as with (b) pictures of the communication partners and their telephone numbers for the video calls. One has also to set up the MacroDroid application with the instructions required to enable the tablet to function (i.e., to present the leisure and communication options and respond to the participant's input) according to the program conditions.

Third, the activation of the tablet's proximity sensor to select the options available and then access and enjoy leisure activities and video calls requires a relatively simple and general response that most participants would be able to provide even when affected by motor impairments. For participants who cannot manage the response, a variation in the technology might be introduced. The variation might involve the use of a smartphone in connection with the tablet. The smartphone could serve to record (i.e., through its proximity or light sensor) minimal responses, such as head, lip or finger movements [30], and make those responses instrumental to cue the tablet (i.e., select the stimuli on the tablet's screen).

Fourth, while investigations preceding the start of the study had indicated that the participants preferred or could only benefit from video calls, specific data collection during the study could have added relevant information in the area. For example, one could have assessed the frequencies of communication exchanges between the participants with receptive verbal skills and their partners during video calls and audio calls or checked the level of satisfaction of those participants with the two types of calls [43–46]. Similarly, one could have recorded and compared the participants' indices of happiness (e.g., smiles and forms of excitement) during the two types of calls [47,48].

Fifth, the two main limitations of the study concern the inclusion of a relatively small number of participants and the absence of a social validation of the program. Regarding the first limitation, research with additional participants is needed to verify the robustness of the data obtained in this study and thus determine the practical implications of such data [31,32]. Regarding the second limitation, new research should include a direct assessment of staff opinion about the program (possibly supplemented with the communication partners' ratings of the calls). Staff would be asked to (a) score the usefulness, affordability and practical benefits of the program and each of its two components (i.e., leisure activities and video calls) and (b) state their preferences between video calls and audio calls [49,50]. Positive opinion about the program with video calls could be seen as an encouraging sign for the acceptance and possible application of such program arrangement in daily contexts [51,52].

In conclusion, the tablet-based program assessed in this study was effective in supporting leisure activities and video calls of participants with intellectual disabilities, sensory and/or motor impairments, and lack of expressive or both expressive and receptive verbal skills, thus strengthening and extending previous evidence in the area [2,11,24]. While these results are very encouraging, general statements about their reliability and practical implications must be suspended until new research has dealt with the limitations of this study. New research may also consider the possibility of upgrading the present technology solution or supplementing it with useful additions [53,54].

Ethical approval

Appropriate institutional approval and written informed consent were obtained for the study. All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Disclosure statement

No potential conflict of interest was reported by the authors.

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